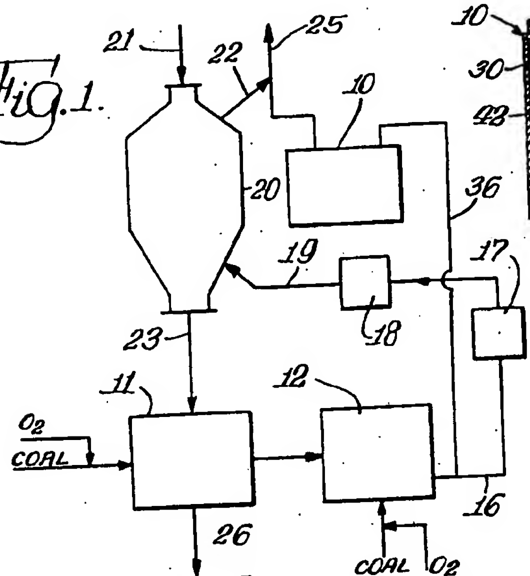
March 31, 1964 R. E. TOUZALIN ET AL 3,126,906

PRESSURE STABILIZING APPARATUS

Filed Sept. 12, 1960

Fig. 1.



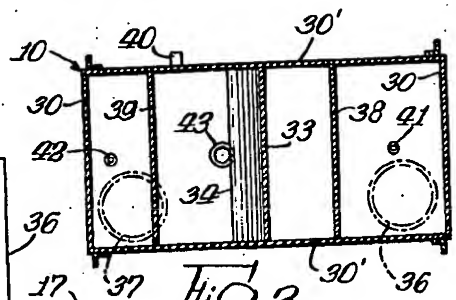
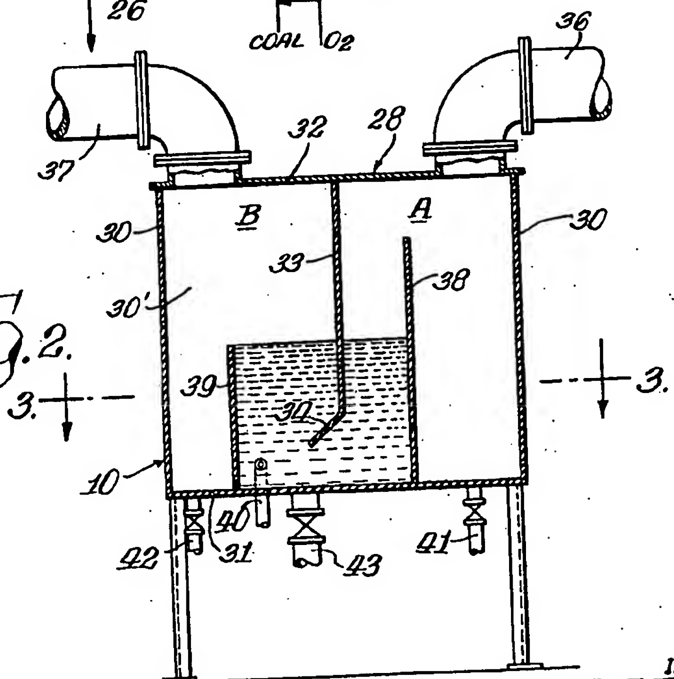


Fig. 3.

Fig. 2.



INVENTORS.
Robert E. Touzalin
Melvin J. Greaves,
By Davis, Lindsey, Hibben & Noyes
Attys.

United States Patent Office
3,126,906
Patented Mar. 31, 1964

3,126,906
PRESSURE STABILIZING APPARATUS

Robert E. Touzalin, Aurora, and Melvin J. Greaves, Cleveland, Ohio, assignors, by mesne assignments, to Inland Steel Company, Chicago, Ill., a corporation of Delaware

Filed Sept. 12, 1960, Ser. No. 55,348
5 Claims. (Cl. 137—253)

The present invention relates generally to apparatus for stabilizing the pressure of a gas system to protect the system against both excessively high pressures and vacuum conditions occurring therein.

It is frequently necessary to operate a system, as in a chemical or metallurgical reaction, at a relatively uniform pressure in order to achieve the desired result efficiently and to avoid damaging parts of the system. Control apparatus, such as pressure regulators and safety valves, are commonly used. In the past, however, apparatus capable of providing adequate protection against both excessive pressure and vacuum conditions has been relatively expensive to construct and operate.

It is, therefore, an object of the present invention to provide an improved apparatus for stabilizing the pressure in a gas system which is efficient and reliable in operation and which is inexpensive to construct.

It is a further object of the present invention to provide an improved gas pressure stabilizing apparatus which does not have movable parts.

It is still another object of the present invention to provide an improved liquid sealed gas pressure stabilizing apparatus which is entirely automatic in operation and does not require the attention of an operator to effect resealing after a pressure upset or when sealing liquid is lost by evaporation, entrainment, or the like.

Other objects of the invention will be apparent to those skilled in the art from the detailed description and drawing which illustrates a preferred embodiment of the invention and wherein:

FIGURE 1 is a diagrammatic view of a metallurgical system in which the apparatus of the present invention is employable;

FIGURE 2 is a vertical sectional view partially in side elevation showing one embodiment of the present invention; and

FIGURE 3 is a horizontal sectional view taken along the line 3—3 of FIGURE 2.

As illustrated in the accompanying drawing, the pressure stabilizing apparatus 10 as shown schematically in FIGURE 1, of the present invention is adapted for use in an iron oxide ore reduction and smelting system which has associated therein a melting hearth 11 and a gas reformer 12. If desired, the hearth 11 and reformer 12 can be combined in a single unit. Coal and oxygen are burned in the hearth 11 to produce sufficient heat therein to melt the reduced ore charge which is introduced to the hearth zone 11 through line 23 and wherein CO_2-rich gas is generated. The CO_2-rich gas passes from the hearth 11 into the reformer 12, wherein additional coal and oxygen are introduced to convert the gas into a CO-rich reducing gas. The CO-rich gas passes through an outlet line 16 to a gas cleaner 17 and is then pumped by a compressor 18 through a line 19 into the bottom of a reducing column 20. Iron oxide ore in a finely subdivided form is introduced into the top of the column 20, as indicated at 21, and flows downwardly through the column 20 in counter-current relation to the upward flowing reducing gas which leaves the column 20 through line 22 and is discharged to the atmosphere through an outlet stack 25, or other process gas system discharge means. The iron oxide ore which is at least partially reduced leaves the bottom of column 20 through

line 23 and enters the melting hearth 11, wherein a bath of molten iron is formed. The molten iron is withdrawn from the hearth 11 through outlet 26.

In the foregoing system, it is contemplated that the hearth 11 and gas reformer 12 will be operated at substantially atmospheric pressure, or at slightly below atmospheric pressure. It is extremely important that the pressure in the gas reformer 12 and hearth 11 be controlled relatively closely to avoid both excessive pressure rise and an excessively high vacuum condition therein. The means for controlling the pressure in the system constitutes the subject matter of the present invention.

One preferred embodiment of the pressure stabilizing apparatus 10 of the present invention is shown in FIGURE 2 of the drawing, wherein a substantially closed chamber 28 having a generally rectangular body section with spaced lateral walls 30 and 30′ is provided with a lower wall section 31 and an upper wall section or cover member 32. The upper wall section 32 has a depending center wall or partition member 33 intermediate the oppositely spaced lateral wall sections 30 and terminates in a short angular portion 34 spaced a short distance above the lower wall 31 of the rectangular chamber. The partition member 33 divides the chamber 30 into first and second compartments (i.e., compartment A and compartment B, respectively) which are approximately equal in size and volume. The compartment A communicates by means of a conduit 36, preferably associated with the cover 32, directly with the gas reformer outlet line 16 (or with any other gas-containing zone wherein the pressure must be controlled). The compartment B communicates through a conduit 37 with an outlet stack or, if preferred, with the atmosphere or other process gas system discharge means substantially at atmospheric pressure. When the pressure stabilizing apparatus 10 is used with an ore reduction process, however, it is essential to connect conduit 37 to a source of reducing gas having a high CO_2 content, as by connecting conduit 37 to the process gas system discharge, thereby avoiding the danger of drawing oxygen into the system.

Extending upwardly from the lower wall 31 is an upstanding weir 38 which extends into compartment A and has its upper end disposed above the lower end of the partion 33 and spaced from the cover member 32. A second weir 39 extends upwardly from the lower wall 31 into compartment B to a point above the lower end of the partition 33. The weir 39 is preferably substantially shorter than weir 38. Water or other sealing liquid is preferably continuously introduced through a supply line 40 into a liquid-receiving chamber formed between the weirs 38, 39 and fills the latter chamber to the height of the weir 39; thereby sealably enclosing the lower end of said partition member 33 and forming a liquid seal between compartments A and B, respectively.

In order to remove the water which spills over either of the weirs 38, 39, respectively, compartments A and B have in the lower wall section 31 thereof drain lines 41, 42, respectively. Each of the drain lines 41, 42 is provided with a water seal, as by having a dip leg or by having the lower end thereof immersed in a tank of water, or the like. The liquid-receiving chamber between weirs 38, 39, is also provided with an emergency drain outlet 43 which is normally closed but which can be opened, preferably automatically, if the pressure in compartment A and line 16 becomes dangerously high or low to rapidly remove the liquid seal and permit immediate flow of gas from one compartment to the other compartment in order to rapidly equalize the pressures therein.

In operation, the water which is continuously introduced through line 40 and fills the chamber between weirs 38, 39, continuously spills over the top of weir 39, and is

drawn off through drain line 42. Under normal pressure conditions, when the pressure in line 16 is substantially atmospheric the level of water in the portion of the water filled chamber within compartment A is at the same level as the water in compartment B, said level corresponding to the upper end of weir 39. If the pressure in line 16 rises above atmospheric pressure, the water level in the portion of the water filled chamber between the partition 33 and weir 38 will be depressed, thereby increasing the overflow of water at the top of weir 39.

If the pressure in line 16, and conduit 36, and thus in compartment A, exceeds a predetermined maximum, the water level will be depressed below the angular baffle portion 34 and gas will flow from line 16 through compartment A past the angular baffle 34 into compartment B where it rises through conduit 37 to the waste stack, or is otherwise vented to the atmosphere. In this way, excessive pressure above a predetermined maximum in line 16 is automatically reduced.

In the event of an emergency, as when a sudden and unexpected increase in pressure develops in the system, the sealing liquid in the chamber between weirs 38, 39 can be rapidly dumped, preferably automatically, through the emergency drain 43 so that the line 16 can be quickly vented to the waste stack or atmosphere through conduit 37.

If a vacuum exists in line 16 and conduit 36, as when the pressure in the system drops below atmospheric pressure, the water level between partition 33 and the weir 38 will rise and if the vacuum is sufficiently great, the water will flow over the top of weir 38 and be withdrawn through drain 41. If the vacuum exceeds a predetermined value, the water level in the portion of the water filled chamber between partition 33 and weir 39 will fall below the angular baffle portion 34 and gas or air will be drawn into chamber A below the angular baffle portion 34 through compartment B and conduit 37 which is connected to the process gas system discharge maintained substantially at atmospheric pressure. The reducing gas thus drawn into compartment A will flow into line 16 through conduit 36, and thereby restore the desired pressure in line 16 and the associated apparatus.

It will be apparent that any desired maximum and minimum pressures can be maintained in the associated system by means of the apparatus of the present invention by varying the dimensions of the chamber 30, including the partition 33 and the weirs 38, 39. It will also be apparent that the angular baffle portion 34 at the lower end of the partition 33 serves to minimize surging of the water in the liquid filled chamber. If desired, the angular portion 34 can be disposed in a horizontal plane and also may be provided with a vertically disposed section extending downwardly from the lower surface thereof to further minimize surging of the sealing liquid.

In the herein disclosed embodiment, it will be observed that in the event of a high pressure condition in line 16, and the liquid seal is broken thereby, the process gas released will be conveyed and pass into a piping system which is designed to handle such gas.

Since sealing liquid is preferably continuously introduced through line 40 into the chamber portion between weirs 38, 39, the apparatus at all times maintains substantially identical pressure in the system regardless of any loss of sealing liquid due to leakage or evaporation. Moreover, the continuous introduction of sealing liquid into the chamber between weirs 38, 39 makes the apparatus instantly self-sealing upon the return to normal pressure in the system following an imbalance. This is particularly valuable in the event of an unexpected blowout of sealing liquid due to excessive pressure in line 16. Also, it will be evident that the compartments A and B are sufficiently large to accommodate all the sealing liquid that can be discharged from the liquid-retaining chamber by a sudden positive or negative gas pressure surge.

It will be apparent from the foregoing description that the pressure stabilizer of the present invention provides a simplified design for a pressure stabilizing apparatus which has no moving parts and has no valvular function and utilizes the sealing capabilities of a fluid without danger of releasing any fluid into the gas system.

Others may practice the invention in any of the numerous ways which are suggested to one skilled in the art, by this disclosure, and all such practices of invention are considered to be a part hereof which fall within the scope of the appended claims.

We claim:

1. A pressure stabilizing apparatus for protecting a gas system against high or low pressure surges comprising a substantially closed chamber having top, bottom, and spaced lateral walls, a partition depending from said top wall between said lateral walls and dividing the chamber into two compartments in flow communication at their lower portions below said partition, a weir extending upwardly from said bottom wall into each of said compartments between said partition and an adjacent spaced lateral wall, said weirs extending above the lower end of said partition and defining a liquid seal zone therebetween, a liquid inlet for supplying a sealing liquid solely to said liquid seal zone of said chamber for providing a liquid seal above the lower end of said partition, a liquid outlet in each of said compartments between each of said weirs and the adjacent lateral wall for withdrawing liquid overflowing said weirs, gas conduit means communicating with one of said compartments for connecting said one compartment solely to the gas system being protected, and gas conduit means communicating with the other of said compartments for connecting said other compartment solely to an external atmosphere at substantially constant pressure, said liquid inlet constituting the sole liquid inlet connection to said chamber and said gas conduit means constituting the sole gas flow connections to said chamber, whereby gas flow through said chamber from one of said gas conduit means to the other is normally prevented by said liquid seal but is automatically permitted in response to a predetermined pressure increase or decrease in said gas system being protected.

2. The apparatus of claim 1 further characterized in that the weir in one of said compartments extends upwardly to a height greater than the weir in the other of said compartments.

3. The apparatus of claim 1 further characterized in that said liquid outlet in each of said compartments is provided with means for preventing passage of gas inwardly therethrough.

4. The apparatus of claim 1 further characterized by the provision of emergency liquid outlet means connected to said liquid seal zone for rapidly discharging sealing liquid therefrom.

5. In an iron ore reduction system wherein a reducing gas is passed from a gas generating zone through a reduction zone and thence to a gas discharge system at substantially constant pressure, a pressure stabilizing apparatus for protecting said gas generating zone against excessive increase or decrease of pressure which comprises a substantially closed chamber having top, bottom, and spaced lateral walls, a partition depending from said top wall between said lateral walls and dividing the chamber into two compartments in flow communication at their lower portions below said partition, a weir extending upwardly from said bottom wall into each of said compartments between said partition and an adjacent spaced lateral wall, said weirs extending above the lower end of said partition and defining a liquid seal zone therebetween, a liquid inlet for supplying a sealing liquid solely to said liquid seal zone of said chamber for providing a liquid seal above the lower end of said partition, a liquid outlet in each of said compartments between each of said weirs and the adjacent lateral wall for withdrawing liquid overflowing said weirs, gas conduit means communicating with one of said compartments for connecting said one compart-

10/29/2003, EAST Version: 1.4.1

ment solely to said gas generating zone, and gas conduit means communicating with the other of said compartments for connecting said other compartment solely to said gas discharge system, said liquid inlet constituting the sole liquid inlet connection to said chamber and said gas conduit means constituting the sole gas flow connections to said chamber, whereby gas flow through said chamber from one of said gas conduit means to the other is normally prevented by said liquid seal but is automatically

permitted in response to a predetermined pressure increase or decrease in said gas generating zone.

References Cited in the file of this patent

UNITED STATES PATENTS

909,871	Cudell	Jan. 19, 1909

FOREIGN PATENTS

396,307	Great Britain	Aug. 3, 1933

10/29/2003, EAST Version: 1.4.1